

**In the claims:**

1. A non-invasive method for measuring the velocity of a free fluid surface flowing in a predetermined direction in an open channel or flume of a fixed shape comprising the steps of:
  - generating a microwave frequency electrical signal adapted to reflect from said fluid surface using a means to generate said electrical signal;
  - spacing the means to generate said electrical signal from said fluid surface;
  - directing said signal along a line toward the fluid surface and opposite the predetermined direction and at an angle of between 30 and 40 degrees to said fluid surface;
  - detecting the signal reflected from the fluid surface; and
  - determining from the directed and reflected signal the Doppler frequency shift therebetween as a measure of the velocity of the fluid surface.
2. The method of claim 1 wherein said directed signal forms a pattern on the fluid surface of an oval shape.
3. The method of claim 2 wherein said spacing is arranged so that said directed signal has an unobstructed cone-shaped view of the fluid surface.
4. The method of claim 3 wherein said spacing is generally between 18 and 48 inches.
5. The method of claim 1 comprising the additional steps of:
  - measuring the depth of the fluid in the channel or flume; and
  - determining from the velocity of the fluid surface and the depth of the fluid in the channel or flume, the flow rate of the fluid.
6. The method of claim 5 wherein the depth measurement is ultrasonically obtained.
7. The method of claim 6 wherein said ultrasonic measurement is non-invasive.

8. The method of claim 7 wherein said non-invasive method includes the steps of:

generating an ultrasonic acoustic signal adapted to reflect from said fluid surface using a means to generate said ultrasonic signal;

spacing the means to generate said ultrasonic signal a predetermined distance above the open channel or flume bottom and above the fluid surface;

directing said ultrasonic signal downwardly at said fluid surface;

detecting the ultrasonic signal reflected from the fluid surface; and

determining from the reflected ultrasonic signal the difference in length therebetween the open channel or flume bottom and fluid surface as a measure of the depth of the fluid in the open channel or flume.

9. A non-invasive method for measuring the velocity of a free fluid surface flowing in a predetermined direction in an open channel or flume of a fixed shape comprising the steps of:

generating an electrical signal adapted to reflect from said fluid surface using a means to generate said electrical signal;

spacing the means from said surface to generate said electrical signal from said fluid surface;

directing said signal along a line toward the fluid surface, wherein said signal has an unobstructed path to the fluid surface;

detecting the signal reflected from the fluid surface, wherein the reflected signal travels through an unobstructed path; and

determining from the directed and reflected signal the Doppler frequency shift therebetween as a measure of the velocity of the fluid surface.

10. The method of claim 9 wherein the signal is directed opposite the predetermined direction.

11. The method of claim 9 wherein the signal is directed at an angle of between 30 and 40 degrees to said fluid surface.

12. The method of claim 9 wherein the signal is of a microwave frequency.

13. A non-invasive method for continuously measuring the volumetric flow of a free liquid flowing in a predetermined direction in an open channel or flume of a predetermined shape and a predetermined cross-section comprising the steps of:

generating an electrical signal adapted to reflect from said liquid surface using a means to generate said electrical signal;

spacing the means to generate said electrical signal from said liquid surface;

directing said signal along a line through an unobstructed path toward said liquid surface;

detecting said signal reflected from said liquid surface;

determining from said directed and reflected signal a Doppler frequency shift therebetween as a measure of the velocity of said liquid surface;

measuring a depth of said liquid travelling through the channel at said predetermined cross-section; and

determining from the velocity of said liquid surface and the depth of said liquid a volumetric flow of said liquid.

14. The method of claim 13 wherein said depth is measured by determining the difference between a predetermined distance between a depth measuring signal source to a bottom of said channel and a distance measured from said depth measuring signal source to said liquid surface.

15. The method of claim 13 wherein said signal is directed at said liquid surface at a predetermined angle.